Ferguson Beauregard iMonitoring iNodes

TLM-3: Tank Level Monitor
User Installation and Operating Manual

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Introduction.

What is an iMonitoring Tank Level Monitor (TLM-3)?

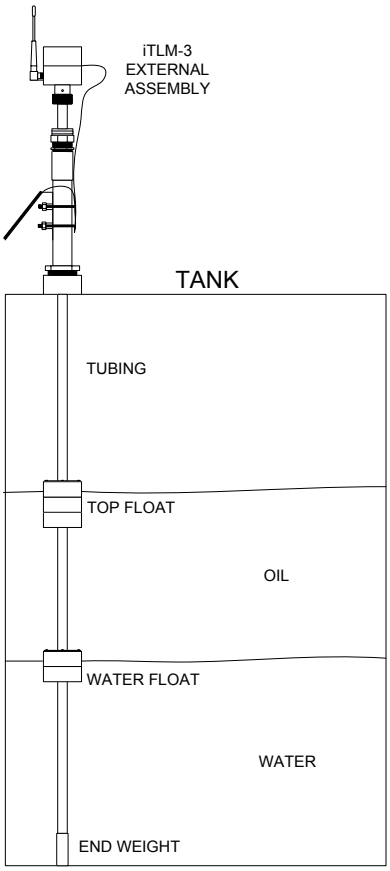


Figure 1. TLM-3 Tank Mounting.

Ferguson Beauregard's iNode Tank Level Monitor (TLM-3) is a self-contained, solar/battery-powered unit used to monitor fluid levels in tanks and silos. Part of the iNodes suite of wireless sensors, it can deliver data remotely over the Internet, or locally to a Compact Flash Radio-enabled laptop PC or PDA. The TLM-3 eliminates cumbersome daily tank gauging, providing 24-hour production data with consistent daily level collection times.

The TLM-3 uses active RFID float / probe technology to provide accurate tank fluid level measurements in either single or two product tanks. Each float contains a battery-powered transmitter. Each float's position is calculated by a probe assembly extending from the top to the bottom of the tank and a sensor head containing a processor, radio and power supply. Top and Water float transmitters transmit different signals so that each float can be independently detected. The specific gravity of each float is carefully adjusted to float on the proper fluid in the tank.

Principal features of the TLM-3:

- Advanced float position sensing technology.
- Reports levels in single product or two product (optional) tanks.
- Optimized for daily production data collection.
- Programmable data collection times for consistent 24-hour production data.
- System includes power supply, processing, data storage and radio communications.
- Eliminates daily onsite tank gauging.
- Intrinsically safe.
- Field configurable and upgradeable by any Compact Flash Radio-enabled PC, including pen tablet PCs, PDAs and our Concentration & Communications Unit.
- Solar powered with rechargeable lithium ion battery.
- Rugged IP65-certified enclosure.
- Comprehensive cry-out alarm capabilities.
- Low cost.

TLM-3 Installation.

Figure 1 shows the main elements of a TLM-3 system mounted on a two-product tank.

Solar Panels and Sunlight

The TLM-3 power supply contains a high-capacity rechargeable lithium ion (Li-Ion) battery, charging circuit and regulator, and an external solar panel. When fully charged, it will typically operate for two weeks without sunlight (depending on configuration). Manmade lighting, such as fluorescent or incandescent lights, cannot generate enough power to power the TLM-3. For reliable operation, the solar panel:

- Must be exposed to ambient sunlight.
- Must face south.
- Must be unshadowed by buildings, trees, etc.

Installation Instructions

The installer must insure that the TLM-3 is correctly installed and provisioned, and that the installation is compliant with all regulatory and safety requirements.

Hardware package.

The standard TLM-3 system is for a single product, 20’ high tank. (Note: fiberglass tubing lengths are determined by the stated tank height + 2’ 6” minimum. For example, a 15’ tank system will contain (2) 7.5’ sections and (1) 2.5’ section.)

- (1) TLM-3 sensor head.
- (1) Antenna.
- (1) Solar panel assembly (solar panel, mounting plate, mounting U-bolts).
- (3) 7.5’ threaded fiberglass tubing sections.
- (1) End weight.
- (20) Probe cards, shipped as the following assemblies:
    - (5) 3-card inline assemblies.
    - (1) 3-card bottom assembly.
    - (2) 1-card inline assemblies.
- (1) Gland nut.
- (1) Top float.
- (1) Water float (optional, if a two product tank).
- (5) Bipax premeasured epoxy packs.
- (1) End weight.

Hardware required but not supplied.

- (1) 2” NPT x 24” iron pipe section.
- (1) 2” NPT female to female pipe union.
- (1) 3” x 2” (or 4” x 2”, depending on tank fitting) NPT flange adapter.

Tools required but not supplied.

- Pipe wrench.
- Crescent wrench.
- Screwdriver, Phillips head.
- Hex wrench, 5/64”
- Hacksaw.
- [Clamp to hold tubing as it’s slid into the tank.]
- Tank level gauging tape.
- Side cutters.

Supplies and materials required but not supplied.

- Kolor-Kut (for water and two product tanks).
- Pipe sealing tape.

Manpower required.

Two men are required for a TLM-3 installation. There are fall hazards involved in handling the tubing assembly as it is lowered into the tank.

Tank installation requirements.

- The tank entry opening must be at least 3” ID NPT to allow clearance for the floats when the TLM-3 is installed. 4” mounting reducers are available.
- There must be sufficient clearance and access above the tank entry opening to allow the tubing sections to be lowered into the tank during installation.
- The TLM-3 must be located where there are no internal obstructions in the tank (e.g. bracing) which could interfere with free float travel.

Pre-installation.

- Gather all tools required for the installation.
- Remove the TLM-3 hardware from its shipping packaging. Check the contents to see that no items are missing or damaged.
- Make sure the tank and tank opening are prepared for installation.

Assembly and installation sequence.

The external part of the TLM-3 (mounted outside the tank) is shown in Figure 2.

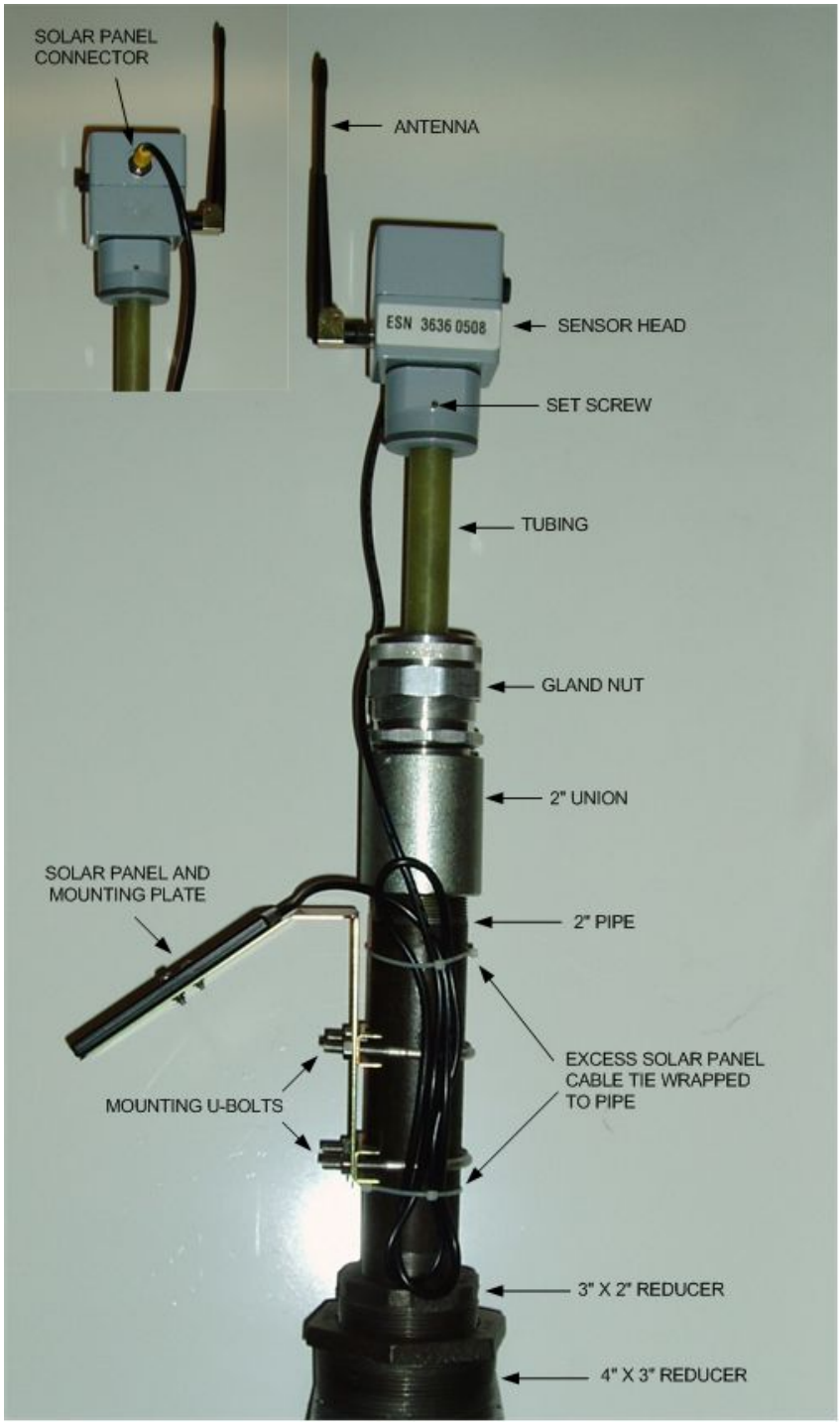


Figure 2. TLM-3 assembly outside tank.

Tubing assembly.

For shorter tanks, two 7.5’ tubing sections can be glued together on the ground. The tubing assembly is light enough to be lifted vertically above the tank, then lowered into the tank opening. Gluing three or more sections on the ground is not recommended, as the additional stress on the joints may result in joint assembly cracks and leaks. The tubing may also be assembled, one section after another, as they are lowered into the tank opening, gluing each joint individually. This takes longer, but it’s easier to handle the shorter sections.

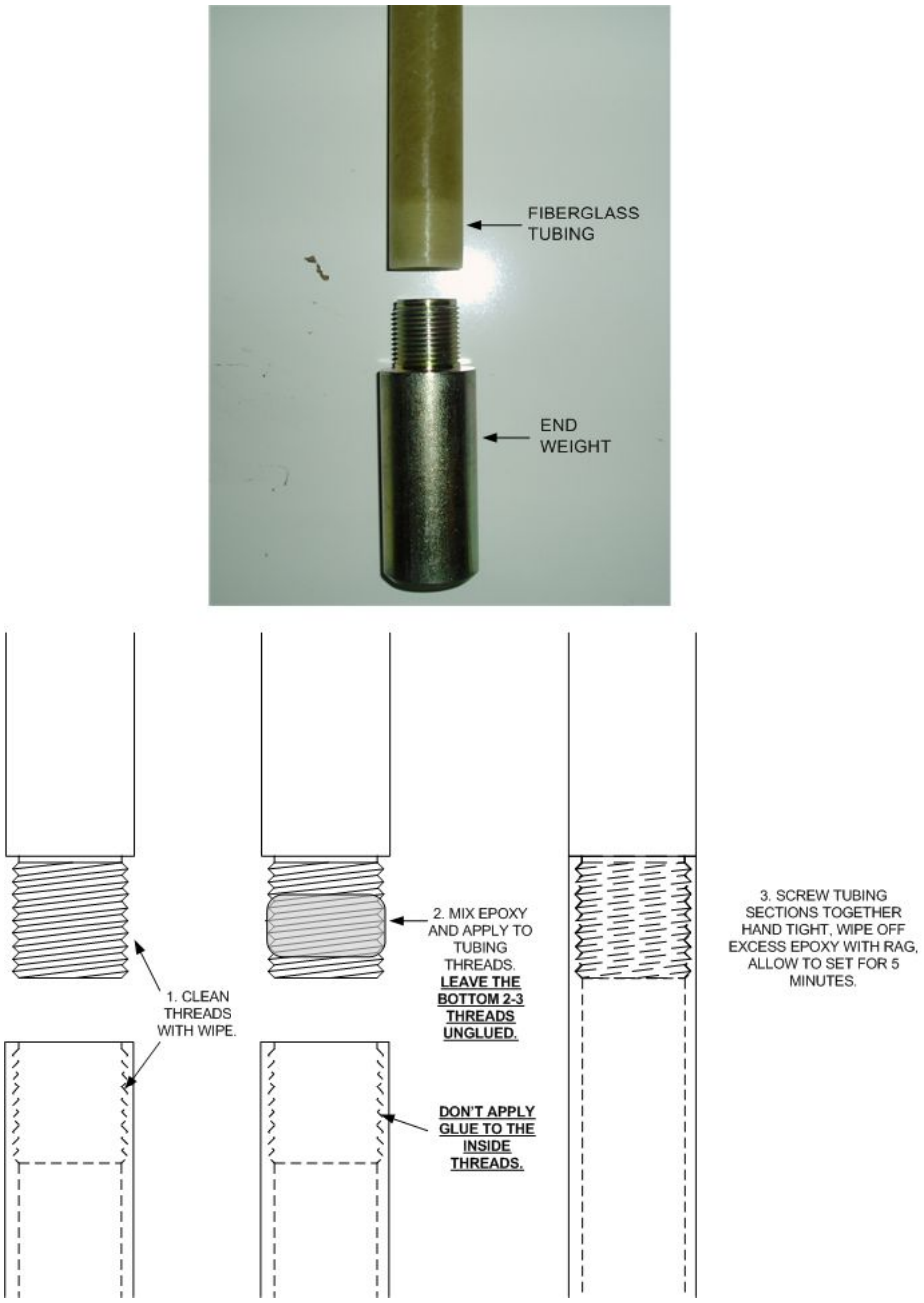

FIBERGLASS TUBING
END WEIGHT
1. CLEAN THREADS WITH WIPE.
2. MIX EPOXY AND APPLY TO TUBING THREADS. LEAVE THE BOTTOM 2-3 THREADS UNGLUED.
DON'T APPLY GLUE TO THE INSIDE THREADS.
3. SCREW TUBING SECTIONS TOGETHER HAND TIGHT, WIPE OFF EXCESS EPOXY WITH RAG, ALLOW TO SET FOR 5 MINUTES.

Figure 3. End weight, tubing and tubing assembly.

1) Figure 3 shows an end weight, tubing section, and tubing assembly steps.
2) Glue the end weight to a 7.5' tubing section.
   a. Clean the threads with a cleaning wipe. If the threads aren't dirty or oily (some fiberglass powder is OK) they don't need to be cleaned.
   b. Remove the separator from the epoxy pack and squeeze the two parts together until the epoxy is thoroughly mixed. Cut a corner off the pack and apply epoxy to the end weight threads, **leaving the first two or three threads clear of epoxy.** Work the epoxy into the threads so that there is no gap in the epoxy which might create a leak. The epoxy has a work life of five minutes at 70°F.

      NOTE: It is very important that no epoxy extrudes into the inside of the tubing. Clearance between the tubing and the probe cards is tight. Any epoxy residue on the inside of the tube may make it impossible to slide the probe cards into the tubing later.

   c. Screw the end weight into the tubing section and hand tighten. Some epoxy should squeeze out when the weight is tightened. Allow the epoxy to set for five minutes.
3) Glue the next 7.5' tubing section to the section with the end weight to form a 15' section.
   a. Clean the tubing threads with a cleaning wipe if necessary.
   b. Apply epoxy to the exterior tubing threads evenly, **leaving the first two or three threads clear of epoxy,** all around the threads so that there is no gap or break in the epoxy.
   c. Screw the tubing sections together hand tight. Some epoxy should squeeze out when the tubing is tightened. **NOTE**: Wipe off any excess epoxy so it won't snag on the gland nut or bind a float as the float passes the joint.
   d. Allow the epoxy to set for five minutes.

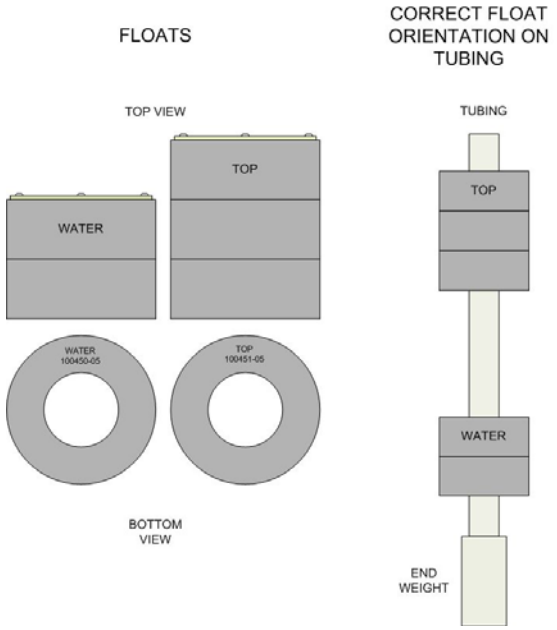


Figure 4. Floats and float orientation on tubing.

4) Slide the Top float (and Water float, if a two product tank) on the first tubing section. Slide them up against the end weight. **NOTE:** The Water float must be closest to the end weight, so that it will be on the bottom. See Figure 1 and Figure 4.
5) Stand the completed tubing section up with the end weight on the ground, and rest it against the tank.
6) Screw the mounting assembly (gland nut, union, nipple and flange adapter) together, using pipe thread tape at each joint to minimize corrosion.
7) Raise the tubing assembly above the top of the tank Carefully slide the end weight and floats into the tank opening until the top of the tubing is about three feet above the opening.
8) Slide the mounting assembly over the tubing assembly, then tighten the gland nut to hold the tubing securely and prevent the tubing from falling into the tank. You may add a clamp the fiberglass tubing for additional security during installation, but this is not typically required.
9) To add more tubing, glue another section of tubing to the tubing already in the tank.
10) Thread the mounting assembly adapter into the tank opening and tighten it securely.
11) 6" to 12" of tubing should protrude from the gland nut. Cut off excess tubing with the hacksaw as necessary. Tighten the gland nut securely.
12) Locate the 3-card bottom assembly (the shrink tubing is pinched closed on the bottom end). Mate its connector into the connector cups of a 3-card inline assembly until the plastic retainer locks. **NOTE: Once the retainer locks, it is very difficult to separate the boards without destroying the retainer.**

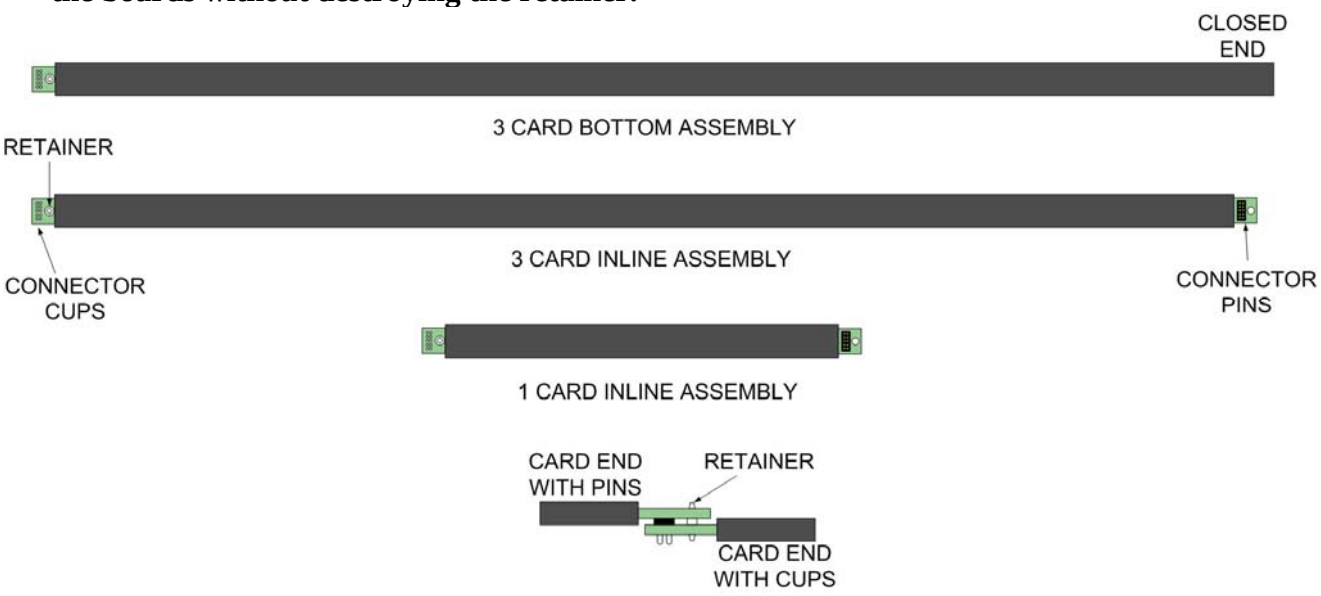


Figure 5. Probe cards and assembly.

13) Slide the end assembly into the fiberglass tubing until the inline assembly's connector is protruding from the tubing. Attach another inline assembly as before.
14) Repeat until all probe assemblies have been mated and inserted into the tubing.
15) Insert the sensor ribbon connector into the top card's top connector.
16) There should be some excess ribbon cable, allowing the bottom assembly to rest against the end weight. Fold the excess cable and slide it into the tube.

17) Slip the sensor head over the tube. Use the 5/64" hex wrench to tighten the two bushing setscrews snugly. **CAUTION:** The setscrews do not have to be extremely tight. Overtightening them may crack the tubing.
18) Attach the solar panel mounting plate to the mounting assembly, turn the solar panel so that it faces south, and tighten the U-bolt nuts.
19) Connect the solar panel output connector to the sensor head.
20) Tie wrap any excess solar panel cable to the pipe.
21) Screw the sensor antenna into the sensor's antenna connector.
22) Remove the reset screw in the bottom of the sensor head. Insert a small tool (e.g. toothpick, paper clip) in the reset hole. Press in gently until you feel a slight click. Hold for a couple of seconds, then release and remove the tool. Replace the reset screw and lightly tighten it.

Configuration and calibration.

1) Before beginning calibration, gauge the tank and record the tank fluid depth(s).
2) Use the following steps to configure, calibrate and verify TLM-3 operation. Open iNodeConfig and select the screen noted at the beginning of each step. If the TLM-3 requires configuration values to be set on that screen, the steps will be noted.
    a. **Config** screen.
        i. Tap **Action-Sync Clock** to synchronize the TLM-3 clock. Confirm the clock is now correct.
        ii. Enter the following values in the **Value** column.

NAME	VALUE
Name	Name of this TLM-3
CCU ESN	CCU which will collect this TLM's data
Number of floats	Set number of floats used on this TLM (1 or 2 floats)
Top level offset, Water level offset	Adjust the displayed level to match the gauged fluid level in the tank (values in inches). Entering a positive number makes the float levels read higher. A negative number makes the float levels read lower.

    b. Check these settings.

NAME	SETTING
Filter size	10 – See manual for detailed explanation
Hysteresis	0.1 – See manual for detailed explanation.

    c. Tap ***Save*** to update the new settings.
    d. Tap ***Refresh*** to confirm that the TLM-3 has accepted the new settings.
    e. Tap **Action** > Site Calibration. Enter the fluid depth(s) measured with the gauge line. Tap ***Calibrate***.
    f. The screen will display "Initiating site cal". If the calibration is successful, a box will display "Site calibration is suceesful. The new offsets are: [Top offset, water offset]. Tap ***OK***.
    g. Tap ***Save***, then ***Refresh*** to verify that TLM-3 has accepted the calibration.

3) **Alarms** screen. Enable and configure alarms only when the customer has contracted for alarms. Note: Use of alarms requires that a CCU ESN be entered on the **Config** screen.
    a. Enable individual alarms by clicking on the alarm type and choosing **Enable** (all alarms are **Disabled** by default).
    b. Set each enabled alarm's trip value.
    c. Tap ***Save*** to update the alarm settings.
    d. Tap ***Refresh*** to confirm the new settings have been accepted.
4) **Diagnostics** screen.
    a. Tap **Mode-Top Float Profile**. A peak will be displayed if the Top float is detected.
    b. Tap **Mode-Water Float Profile.** A peak will be displayed the Water float is detected.
    c. Tap **Mode-Coil Self-Test**. Each coil number will be followed by either a '1' or 'Failure'. Verify that all probe coils display '1'.
5) **Status** screen.
    a. Verify that the Radio, Clock and FLASH tests display 'OK'.
    b. Verify that 'Currently in error state' displays 'No'.
    c. Verify that 'Charge current' is not zero. If the solar panel is in bright sun and the battery is not fully charged, the value will typically be > 40. Values will be lower in weak sunlight or with a fully-charged battery.
6) Operational confirmation.
    Select **Data** screen, select **Transducer Data** and tap **Refresh**.
    Confirm the following values are as expected:
        i. **Top level (**and **Water level**, if a 2 float system).
        ii. **Energy level** (ideally 100% but okay if >75% and increasing).
        iii. **RSSI margin** (>20).
        iv. **Device status** (**Normal**, not in an alarm condition).
7) Save the configuration.
    a. Tap the **Config** tab. Tap **Action-Export Config**.
        i. PDA: Enter the file name in **Name**, select the folder in **Folder**, leave **Type** empty, select the location in **Location** and tap **OK**.
        ii. PC: Browse to the directory that you wish to use, enter a filename and tap **Save**.

iNodeConfig

Local communication with iNodes is necessary for configuration, maintenance and local data acquisition. The same radio system which is used to collect data from iNodes by a CCU is also used for local communications. The local communications software, called **iNodeConfig**, allows you to configure iNodes, set controls and view or save data and configurations.

iNodeConfig is available in two versions: **iNodeConfig-PDA**, which runs on all PDAs with the Windows CE operating system, and **iNodeConfig-PC**, which runs on laptops and PCs with Windows 2000, NT or XP. Both versions require an iMonitoring Compact Flash Radio card (CFR) installed in a Compact Flash port (or PCMCIA port, with a Compact Flash to PCMCIA adapter). The two versions are as similar as possible to minimize confusion when switching between a PDA and a laptop.

In most cases the following sections are presented starting at the leftmost user screen and moving to the right, one screen at a time. Each user screen shown on the iNodeConfig screen toolbar is denoted by bold type, e.g. "**Data** screen". Configuration or selection items within each screen are also denoted by bold type, e.g. "**Configure**".

In these sections you will be be instructed to "tap" a button or location on the screen. On the PDA, tapping means actually tapping the button or location with the PDA stylus. On PCs, tapping means moving the cursor over the button or location, then "tapping" with a mouse pad or clicking with the left mouse button.

Wherever practical, the iNodeConfig PDA and PC screen figures will be shown side by side so that you can see the similarities and differences between them. In larger screens, the PDA screen will be shown first, and the PC screen will be shown second.

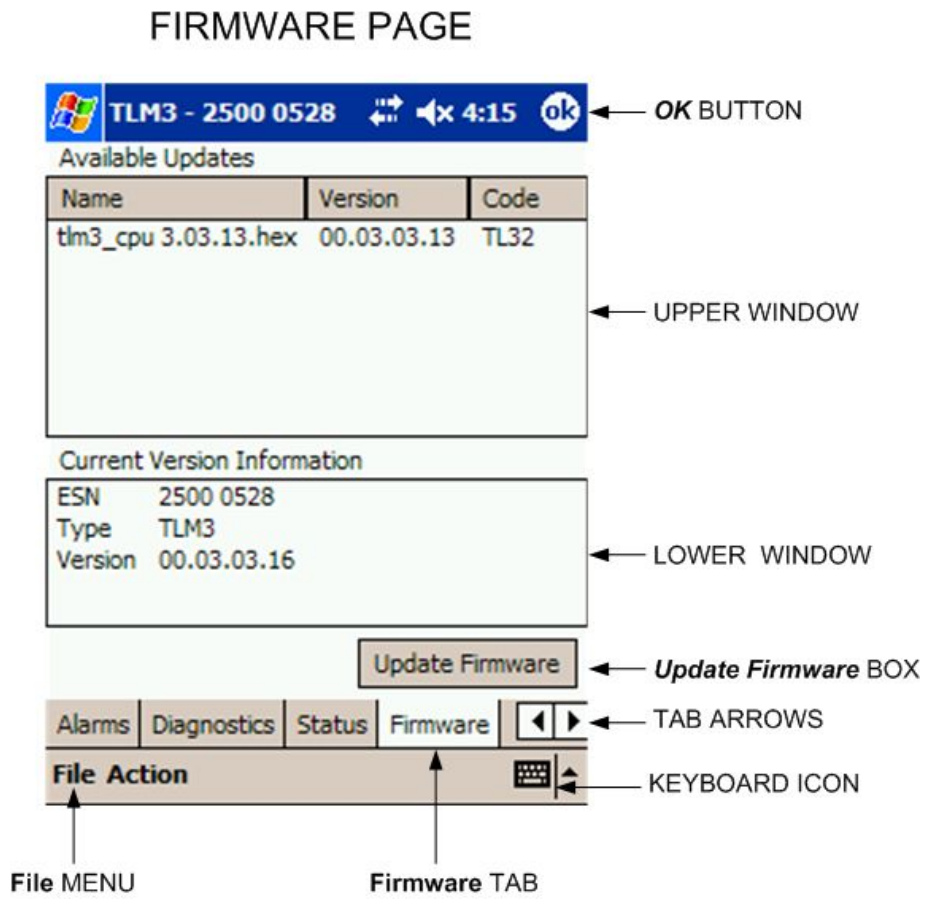
The main differences between iNodeConfig-PC and iNodeConfig-PDA are:

- The PDA version uses the Windows CE standard tools and features, particularly the keyboard icon and the OK button at the top right of the screen. The PC version uses the Windows standard tools: the Minimize – Maximize – Close buttons at the top right of the screen, sizeable windows, etc.
- There is no keyboard icon in the PC version.
- In the PDA version, the page tabs are across the bottom of the screen. In the PC version, the page tabs are across the top of the screen.

iNodeConfig-PDA

iNodeConfig uses about 800KB of storage space on your PDA. There is no setup application; simply copy the iNodeConfig fileset into a folder on the PDA. Use File Explorer to browse to the iNodeConfig folder and touch the "iNodeConfig" icon to start iNodeConfig. See your PDA documentation for instructions on copying files to folders and creating start menu icons.

iNodeConfig PDA screen layout



All iNodeConfig PDA screens have similar views and tools. To understand the instructions in the iNodeConfig PDA section, you should become familiar with them. The Firmware page, which you can choose to view after connecting to a TLM-3, contains most of the views and tools, which will be referred to as follows:

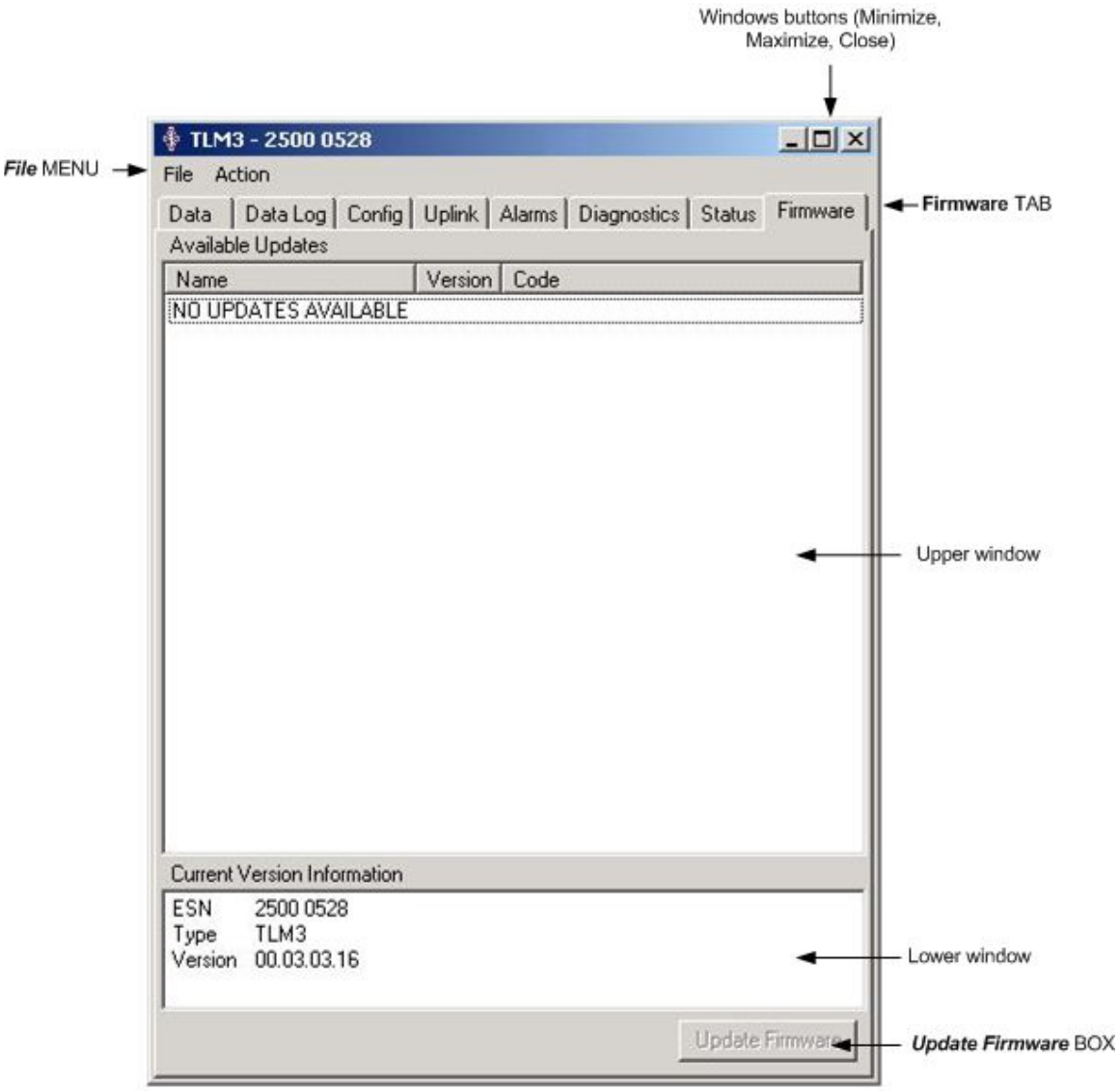
- ***OK*** button: The white circle at the top right of the screen containing the letters "ok". If you tap this button on this page, iNodeConfig will return to the Connection page (more on this later).
- Upper window: Some pages have only one window; others, like the Firmware page, have two. The upper window usually contains one or more items that can be selected.
- Lower window: This window usually contains information items.

- ***Update Firmware*** box: Most pages have one or more action boxes like this one. If you tap a box, the action described by the box text is performed.
- Keyboard icon: This is part of the PDA operating system. If you tap this icon, a keyboard will pop up to allow you to enter text and numbers. iNodeConfig usually will pop up the keyboard automatically if you tap an editable value.
- Tab arrows: There is a tab to select each page. In most cases, not all tabs can be displayed at the same time. You can tap the left (◄) and right (►) tab arrows to slide the tab set so you can locate the tab you want to choose.
- **Firmware** tab: Eight pages can be chosen after you connect to a TLM-3 with iNodeConfig. These pages are chosen by tapping the tab of the page you want to see.
- **File** menu: Most pages have pull-up menus, located at the bottom left of the screen. If you tap a menu, one or more choices will pop up. File choices relate to importing and exporting types of files into iNodeConfig.

iNodeConfig-PC

iNodeConfig uses about 1.5MB of storage space on your PC. A setup application installs iNodeConfig on your PC. After installation, use File Explorer to browse to the iNodeConfig folder and tap the "iNodeConfig.exe" icon to start iNodeConfig. You may want to copy and paste the icon as a shortcut to your laptop's desktop for easier access to the program.

iNodeConfig PC screen layout

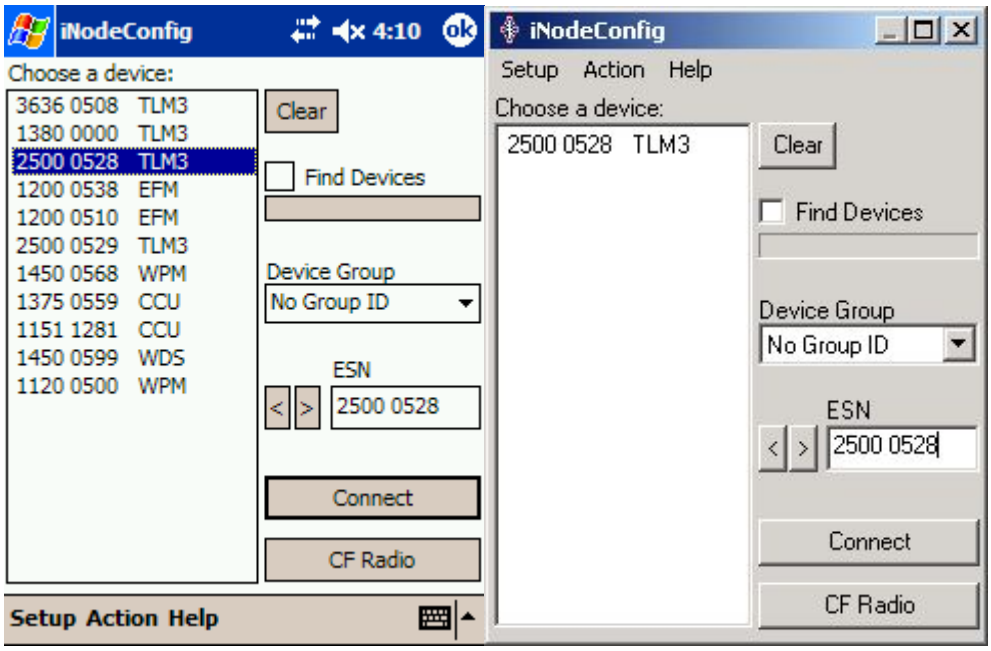


FIRMWARE PAGE

All iNodeConfig-PC screens have similar views and tools. To understand the instructions in the iNodeConfig section, you should become familiar with them. The Firmware page, which you can view after connecting to a TLM-3, contains most of the views and tools, referred to as follows:

- Windows buttons (Minimize, Maximize, Close): These are the standard Windows buttons. They behave as in other programs.
- Upper window: Some pages have only one window; others, like the Firmware page, have two. The upper window usually contains one or more items that can be selected.
- Lower window: This window usually contains information items.
- ***Update Firmware*** box: Most pages have one or more action boxes like this one. If you tap a box, the action described by the box text is performed.
- **Firmware** tab: Eight pages can be chosen after you connect to a TLM-3 with iNodeConfig. These pages are chosen by tapping the tab of the page you want to see.
- **File** menu: Most pages have pull-down menus, located at the top left of the screen. If you tap a menu, one or more choices will be presented. File choices mainly relate to importing and exporting types of files into iNodeConfig.

Device Selection page



After it starts, the first screen iNodeConfig displays is the Device Selection page.

Device Selection page actions

- Choose an existing iNode device by its Electronic Serial Number (ESN) from the ESN list.
- Find iNodes and automatically add their ESNs to the list.
- Clear ESNs from the list.
- Enter an iNode ESN manually.
- Configure the CFR.
- Create a Device Group and assign a Group ID to the Group.
- Enter Setup screen.
- Enter Help Screen.

To choose an existing iNode device from the ESN list:

- Tap the ESN for the iNode.
  - If you double-tap, the ESN will appear in the ESN box, or
  - Tap the > box. The selected ESN will appear in the ESN box.
- Tap the ***Connect*** box.

To find iNodes and add them to the ESN list:

- Tap the ***Find Devices*** checkbox.
- The bar beneath ***Find Devices*** scrolls back and forth as iNodeConfig searches for iNodes.
- As iNode ESNs are found, they are added to the ESN list. Each added ESN will have an ***** to the left of its ESN.
- Tap the checkbox again to uncheck it and stop the find process.

To clear ESNs from the ESN list:

- Tap an ESN to highlight it.
- Tap the ***Clear*** box.

To manually enter an ESN:

- Tap the Keyboard icon at the bottom right of the PDA screen. The keyboard will pop up.
- Tap inside the ESN box.
- Use the keyboard to enter the ESN. (Valid characters are numbers “0” through “9”, and letters “a” through “f”. The first digit must be numbers “0” - “3”.)
- To save the ESN in the ESN list, tap the < box to the left of the ESN box. The ESN is copied to the ESN list.
- Tap the ***Connect*** box.

To configure a Device Group and assign a Group ID:

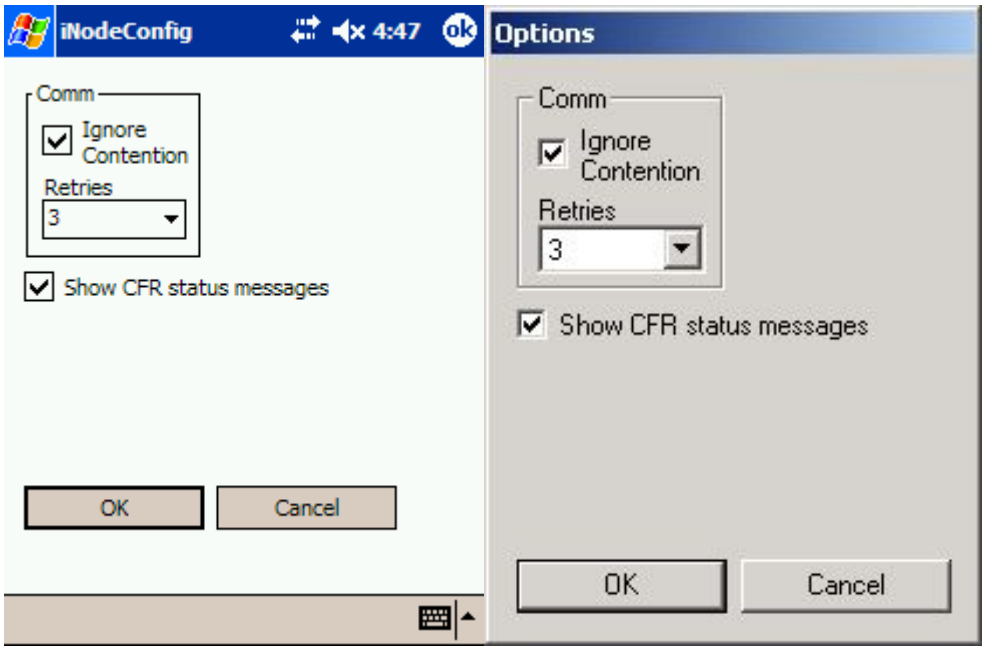
- Contact Ferguson Beauregard customer support for assistance on this feature.

Device Selection menus

- **Setup.**
- **Action.**
- **Help.**

Setup menu items:

- Options.
- Group IDs.
- Demo Mode.
- User Levels.



The Options page allows you to:

- Set behavior with contention and the number of retries.
- Show CFR status messages.

Change these settings as desired, then tap the ***OK*** box to enable the changes and return to the Device Selection screen, or tap the ***Cancel*** box to exit without making changes.

Contention takes place when another iNode, iNodeConfig or a SCADA radio system is transmitting as you try to communicate with a device - the signals interfere with each other. iNodeConfig normally detects contention, displays a Contention error and stops transmitting. If Ignore Contention is checked, iNodeConfig will continue to transmit even during contention, and no error will be displayed. This is usually an undesirable setting, since it allows you to interfere with other devices' communications. The default setting is disabled (unchecked).

Retries sets the number of times iNodeConfig will try to establish communications with an iNode before quitting. In situations where there is more interference, more retries may be needed. You can choose 0 through 10 retries. The default setting is 3.

Show CFR status messages allows you to watch the communications progress and messages between a CFR and an iNode. Expert users enable status messages when troubleshooting communications problems. Leave this feature disabled unless instructed by iMonitoring.

Group IDs

Groups are used to prevent unauthorized access to iNode data. This feature is risky, as it is possible to lock users out of devices if the group code is lost or forgotten. Contact Ferguson Beauregard customer support for instructions on the configuration and use of this feature.

User Levels

Three user levels are defined in iNodeConfig: Pumper, Installer and Administrator. Pumpers can view data but not make configuration changes. Installers can view data and fully configure the iNode. Administrators can change an iNode's ESN, shut it down, etc. The default level is Installer. Administrator level requires a password.

Demo Mode

Demo mode simulates viewing data and configuring an iNode without communicating with a real device. This option is often used in training.

Action menu item selections:

- Clear Device List
- Find Devices
- Connect to Device...
- Configure CF Radio

Clear Device List clears all ESNs in the Device List. A caution box is displayed first, asking if you're sure you want to clear the list.

Find Devices is the same as the ***Find Devices*** checkbox.

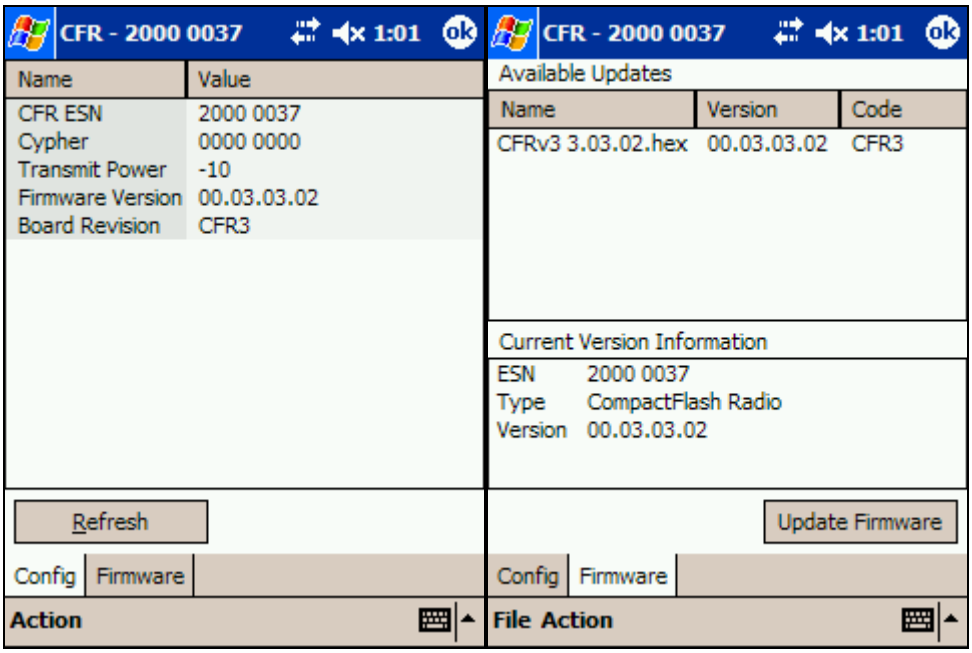
Connect to Device ... is the same as the ***Connect*** box.

Configure CF Radio is the same as the ***CF Radio*** box.

The **Help** - About screen displays iNodeConfig files and versions.

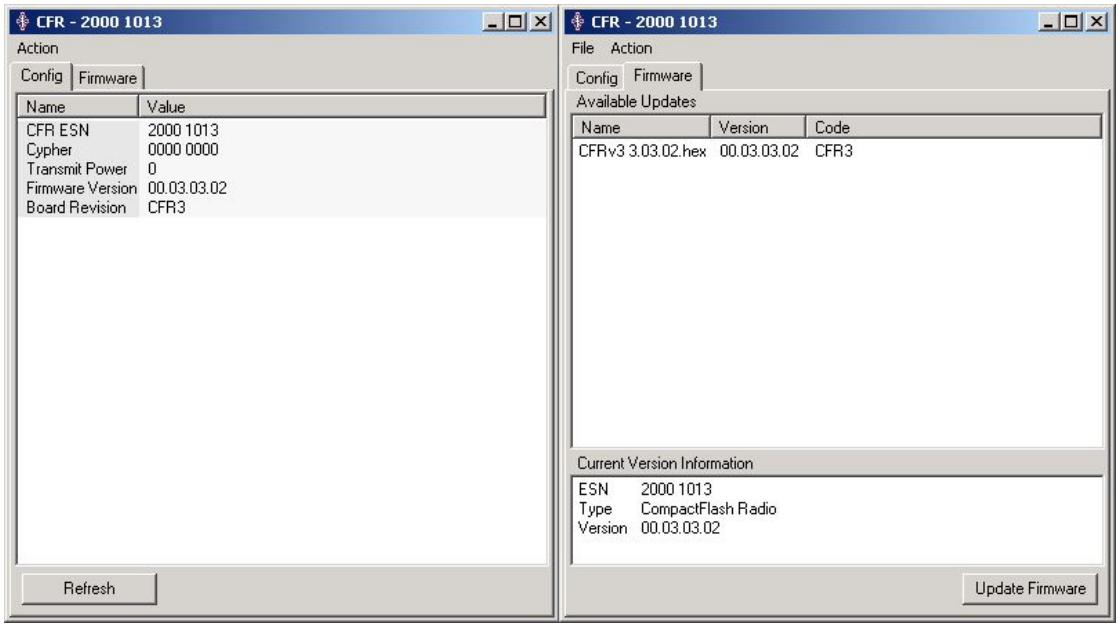
CFR pages

Tap the ***CF Radio*** button to view the CFR pages. The **Config** page displays CFR information: ESN, transmit cypher, power setting, firmware version and board revision. The **Firmware** page allows you to update the CFR firmware.



CAUTION: Do not update CFR firmware without direction from Ferguson Beauregard customer support.

To close the CFR screen, tap the ***OK*** button or the Windows Close (X) button. iNodeConfig returns to the Device Selection screen.



The **Config** page displays the CFR's current device settings. Tap the ***Refresh*** button to refresh the information.

Config menus

The **Config** menu has one item: **Action** > Refresh, which is the same as the ***Refresh*** box.

The **Firmware** page displays the current CFR firmware revision, as well as any available firmware updates.

To update CFR firmware:

- On the PDA, CFR firmware files must be stored in the iNodeConfig folder. On the PC, you can browse to other folders to find CFR firmware files. After browsing to a folder, Refresh Available Updates to see the firmware files. All CFR firmware files will be listed in the upper window of the Firmware page.
- Tap the firmware (.hex) file you want to load to highlight it. (e.g. "CFRv3 3.03.02.hex" is Version 3.03.02.)
- Tap the ***Update Firmware*** button. The selected file will be loaded into the CFR's flash memory.
- The new firmware version will be displayed on the **Update** page.

Firmware menus

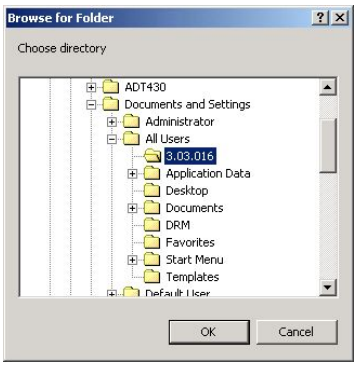
- **File.**
- **Action.**

File menu item selections:

- Browse directories.
- Refresh available updates.
- Update firmware.

- Refresh version info.

Browse Directories ...
PDA: Nonfunctional.
PC: You can browse to any directory containing CFR firmware updates, tap the folder, and tap the ***OK*** button. To see the update files in the upper screen, tap Refresh Available Updates to display the firmware file(s).

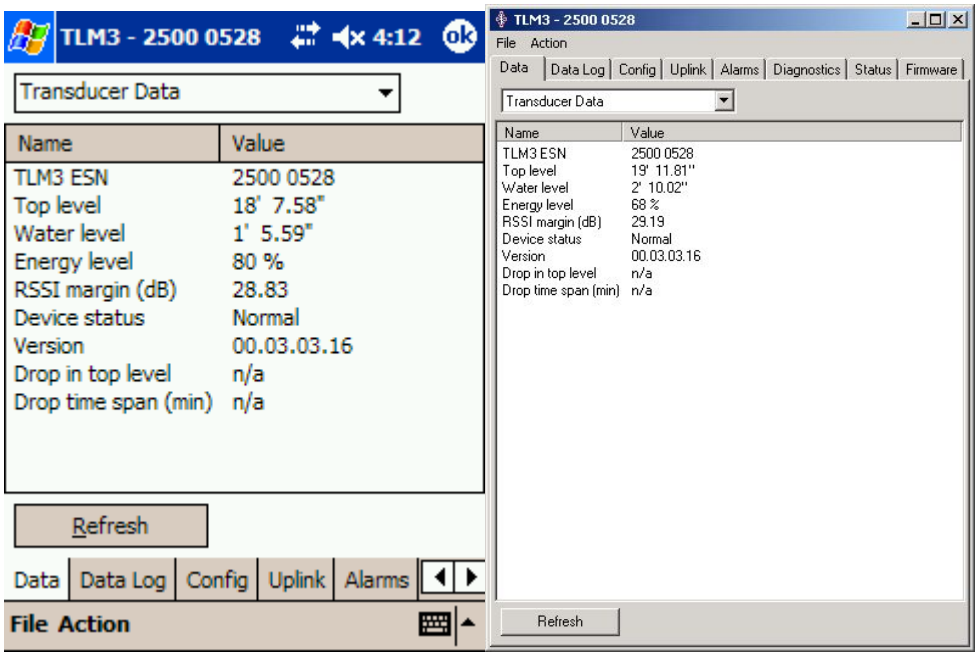


Refresh Available Updates ... If you copied a new CFR firmware file into the iNodeConfig folder on your PDA or browsed to a new folder on the PC, tap Refresh Available Updates to display the new file in the upper window without closing and restarting iNodeConfig.

Update Firmware is the same as the ***Update Firmware*** button.

Refresh Version Info. If new firmware has been loaded, Refresh Version Info updates the firmware version information displayed on the page.

Data page



After connecting to a TLM-3, iNodeConfig displays the **Data** screen, which contains all data related to liquid level inside the tank as well as TLM-3 status information. A pulldown list at the top allows you to view three data formats:

- Transducer data. The most current data. Includes historical average, min and max data.
- RTU data. The data collected by an RTU. Does not include historical data.
- SatCom data. The data collected (and uplinked) by a CCU. Does not include historical data.

You will probably want to view Transducer Data, since this is the most current data available. Since the TLM-3 periodically updates data, tap the ***Refresh*** button to see the most recent data.

Data values and definitions

Item	Definition
TLM-3 ESN	Electronic Serial Number (ESN) of the TLM-3
Top level	Position of the Top float, referenced to the tank bottom.
Water level	Position of the Water float, referenced to the tank bottom.
Energy level (V)	The charge in the battery in percent.
RSSI margin (dB)	The Received Signal Strength Indicator value, a measure of the signal strength received by the TLM-3.
Device status	Indicates alarm conditions. If an alarm is present, a code and a brief fault description are displayed.
Version	The TLM-3 firmware version.
Drop in top level, Drop time span	If the level drop alarm is enabled, these will display the level drop in feet and inches, and the drop time. See the Alarms section.

Data menus

- **File**
- **Action.**

File menu item:

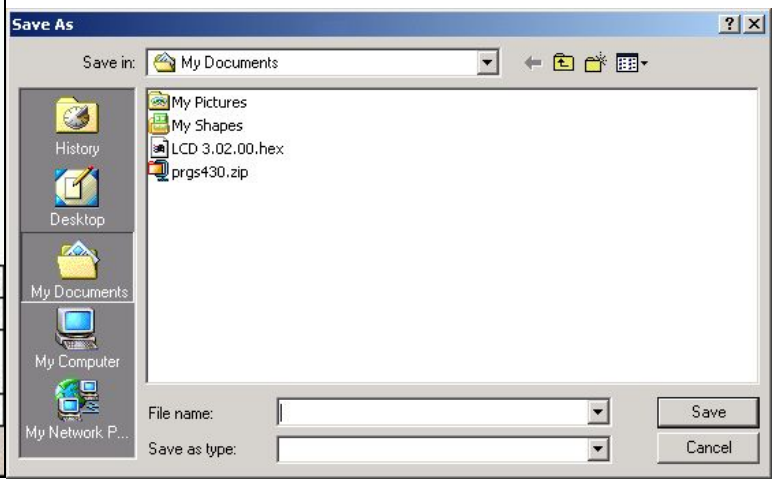
- Export.

Data can be exported to a file in CSV format, supported by most spreadsheet programs. To export a Data file, tap ***File***, then ***Export***, then:

- Enter a file name.
- Browse to the folder where you want to save the file. The only file type currently supported is CSV.
  - PDA: You can save the file in Main Memory, Built-in Storage, or an SD Card, if one is present on your PDA.
  - PC: You can save the file in any folder.
- Tap the ***OK*** button.

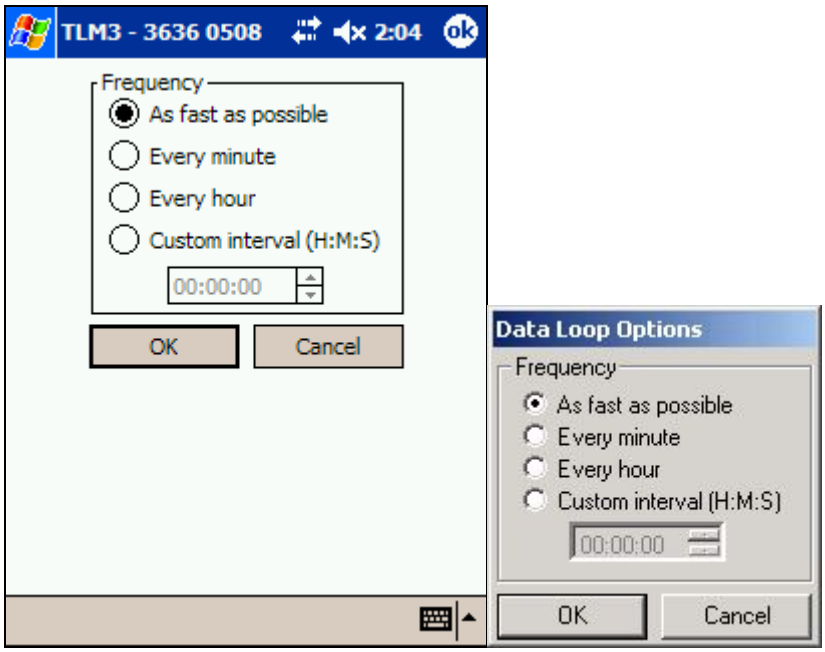
Action menu items:

- Refresh.
- Data Loop.

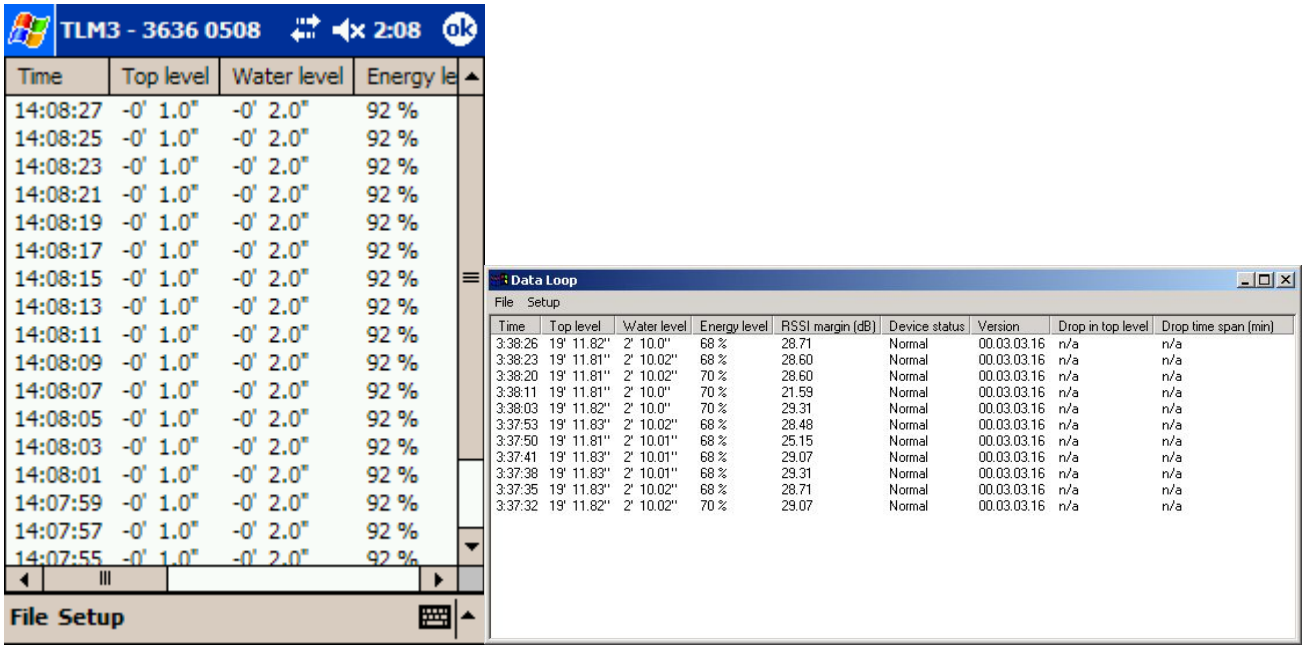


Refresh is the same as the ***Refresh*** button.

Data Loop... When Data Loop is enabled, iNodeConfig will collect data from the TLM-3 continuously. After selecting Data Loop, the Frequency dialog box, which allows you to set the data collection rate, is displayed:



After choosing a Frequency, tap ***OK.*** The collected data is displayed, most recent data at the top of the page.



Data Loop collects:

- Time of collection
- Top level
- Water level
- Energy level
- RSSI margin

- Device status
- Version
- Drop in top level
- Drop time span

To save the data for later review, you must first enable data logging. **NOTE**: Any data displayed before data logging is started cannot be saved later. See **File** – Log Data below.

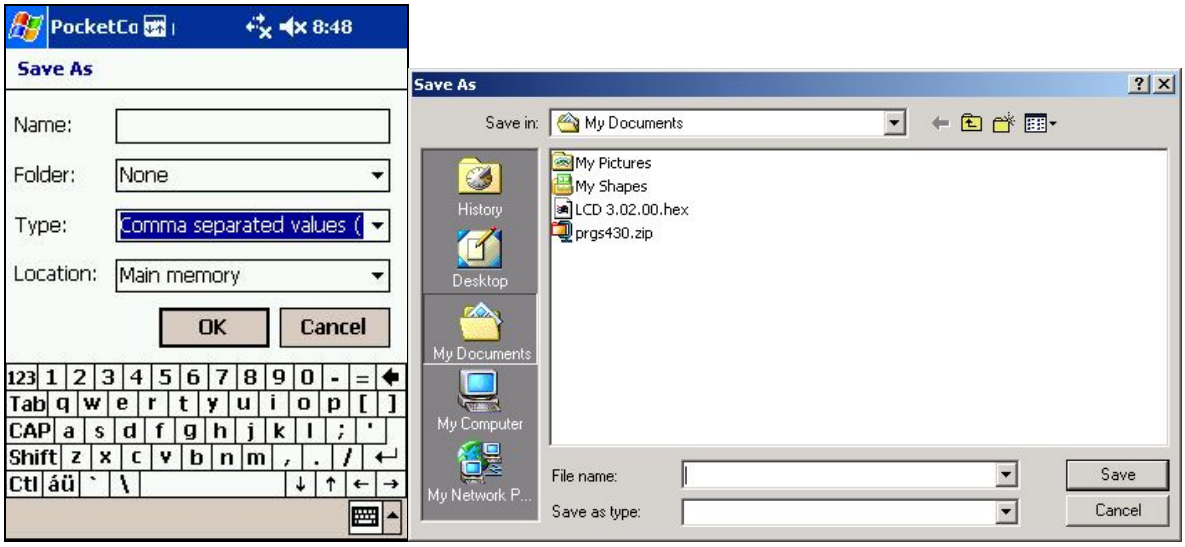
Data Loop menu selections

- **File.**
- **Setup.**

File menu item.

- Log Data...

Log Data saves Data Loop data to a CSV file. If you select this feature, the **Save As** dialog is displayed. (This is not the same as the Data Log page, explained in the next section.)



To log data,

- Enter a file name.
- Choose a folder.
- Tap the ***OK*** button.

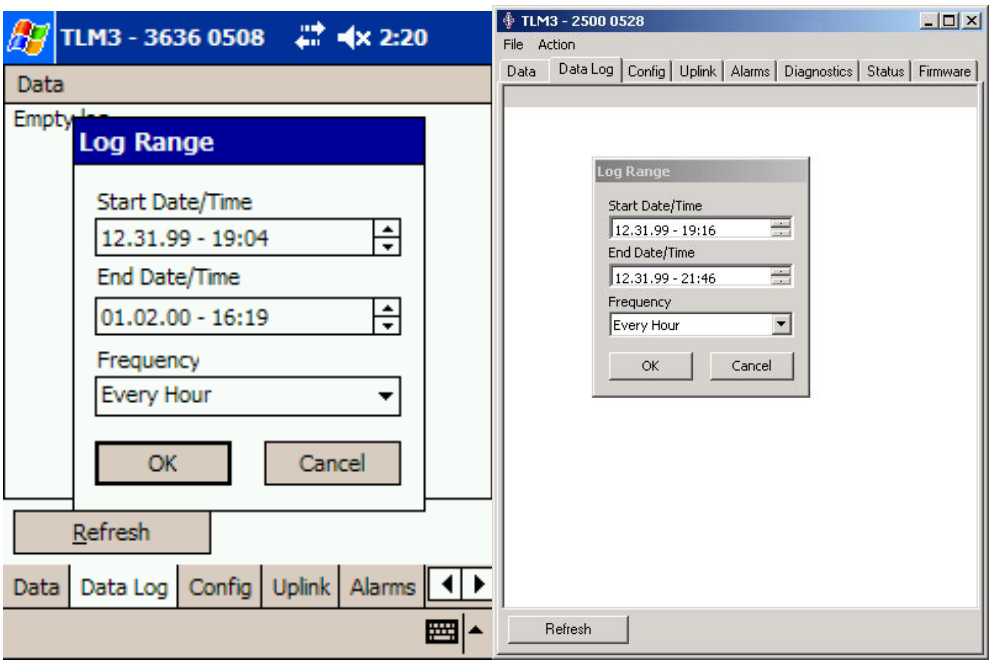
The PDA cannot display the contents of this file directly. You must first move it to a laptop or desktop PC using ActiveSync, then view it with a spreadsheet program. Logging will continue until you exit the Data Loop page (tap ***OK***). The PC can display the file contents if it has a spreadsheet program.

Setup menu item:

- Options redisplays the Frequency dialog.

Data Log page

The TLM-3 logs up to 30 days of data collected at one minute intervals. The Data Log page allows you to view and export the data log.



Data Log page actions

- View the data log.
- Export the data log.

To view the data log,

- Tap the Data Log page. The Log Range dialog box will open.
- Specify the Date / Time range and the interval between entries (frequency).

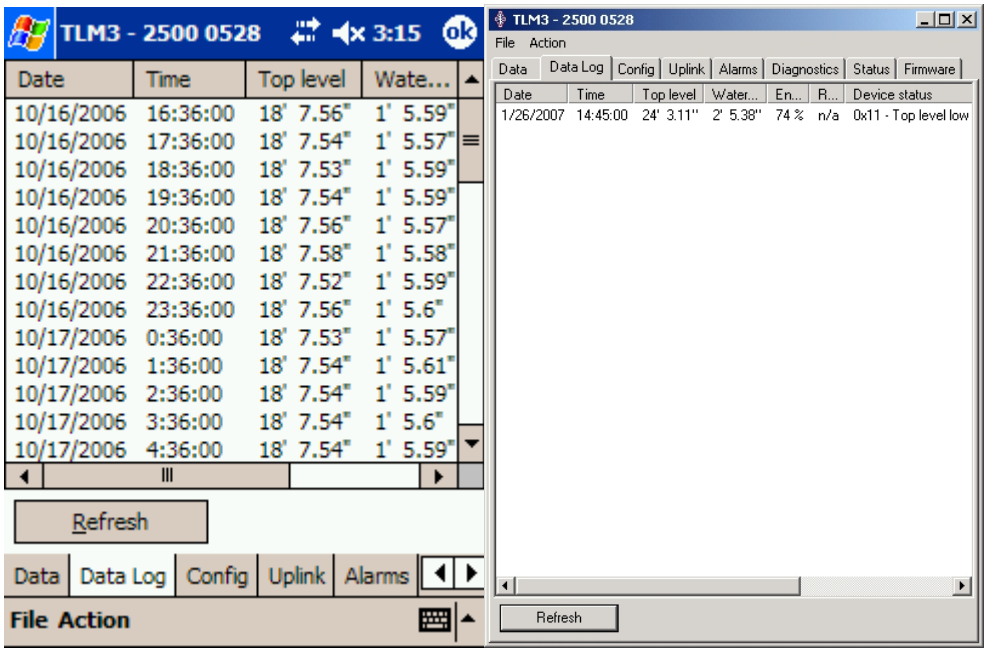
Start and End Dates/Times are automatically set to the start and end of the log. You can enter a date and time later than Start, or earlier than End. You can also choose the frequency (interval between entries): 5 minutes, 15 minutes, 1 hour, 6 hours, 12 hours or 1 day. (Longer intervals show less data but load it faster.)

- After making your date and time selections, tap the ***OK*** button. The data log is downloaded.

The Data Log displays:

- Date and time of entry.
- Top level.
- Water level.
- Energy level.
- RSSI.
- Device status.

- Version.
- Drop in Top level.
- Drop time span (min).



Data Log menus

- **File**
- **Action.**

File > Export. Log data can be exported to a CSV file. This procedure is described in the Data screen section.

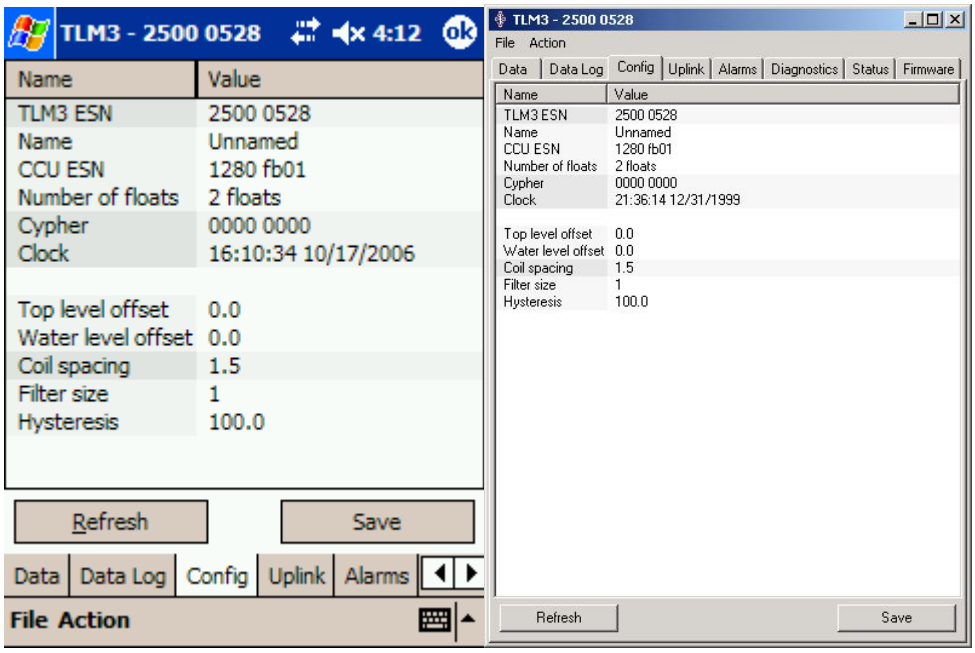
Action menu items:

- Redraw.
- Refresh/Acquire...

Redraw refreshes the log data on the screen.

Refresh/Acquire... displays the **Log Range** dialog box, allowing you to choose a different date, time or frequency.

Config page



The TLM-3, excluding uplinks and alarms, is configured on the Config page.

Config page actions

- Enter a CCU ESN (only required for uplinks and alarms support).
- Name the TLM-3 for easier identification.
- Synchronize the TLM-3 real-time clock (RTC) to the PDA clock.
- Set the number of floats in the system.
- Calibrate the Top and Water float levels to match a manual level gauge.
- Set the Filter Size and Hysteresis values.

To enter the CCU ESN:

- Tap inside the **CCU ESN** box. On the PDA, the keyboard pops up.
- Enter the CCU ESN.
- Tap the ***Save*** button.

To set the number of floats:

- Tap the **Number of Floats** value.
- Select **1 float** or **2 floats**.
- Tap the ***Save*** button.

To calibrate float offsets:

- Manually gauge the tank fluid level(s), then check the Data page. Record the gauged levels and displayed TLM-3 levels.
- Tap the **Offset Level** value. On the PDA, the keyboard pops up.

    - If the gauged level is higher than the TLM-3 level, subtract the TLM-3 level from the gauged level. Enter the difference as a positive number.
    - If the gauged level is lower than the TLM-3 level, subtract the gauged level from the TLM-3 level. Enter the difference as a negative number.
- Tap the ***Save*** button.

Filter Size and **Hysteresis** are used to eliminate false readings, which occasionally occur due to fluid turbulence, etc. **Hysteresis** is the minimum change in level which activates the **Filter** (default = 1"). **Filter Size** is the number of level samples which must be taken by the TLM-3 before it will update the level reading on the Data page (default = 10).

For example, if default values are used, a level change of 0.5" or less will be seen when the TLM-3 takes its next reading (once a minute). However, a 2" level change requires 10 samples (10 minutes) before the level reading on the Data page will display the new level. If only one sample jumped by 2', the 2' change would never be displayed.

If data is only uplinked once a day, the only reason to change the default filter and hysteresis values is to speed up alarm detection.

To change the **Filter Size** and **Hysteresis** values:

- Tap the value you want to change. On the PDA, the keyboard pops up.
- Enter the new value.
- Tap the ***Save*** button.

To synchronize the TLM-3 RTC to the PDA or PC clock:

- Tap the **Sync to PC** button.
- The TLM-3 clock is set to the PDA or PC clock date and time.

Config menus

- **File**
- **Action.**

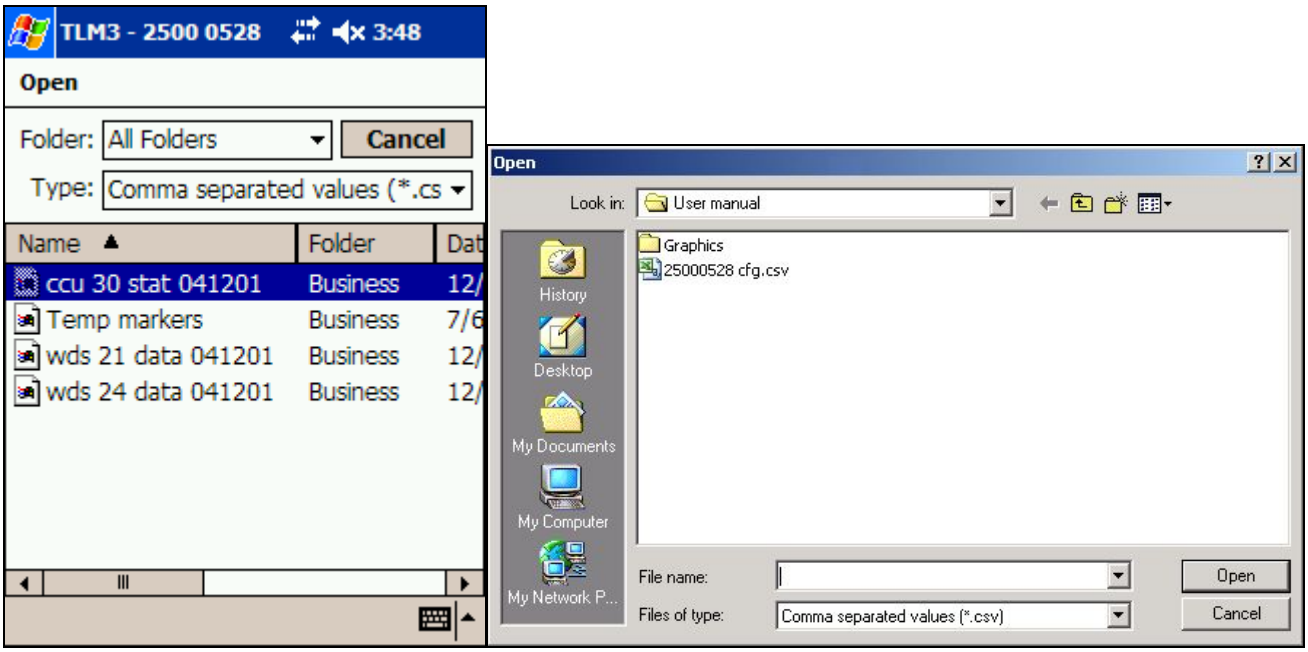
File menu items:

- Import Config ...
- Export Config ...

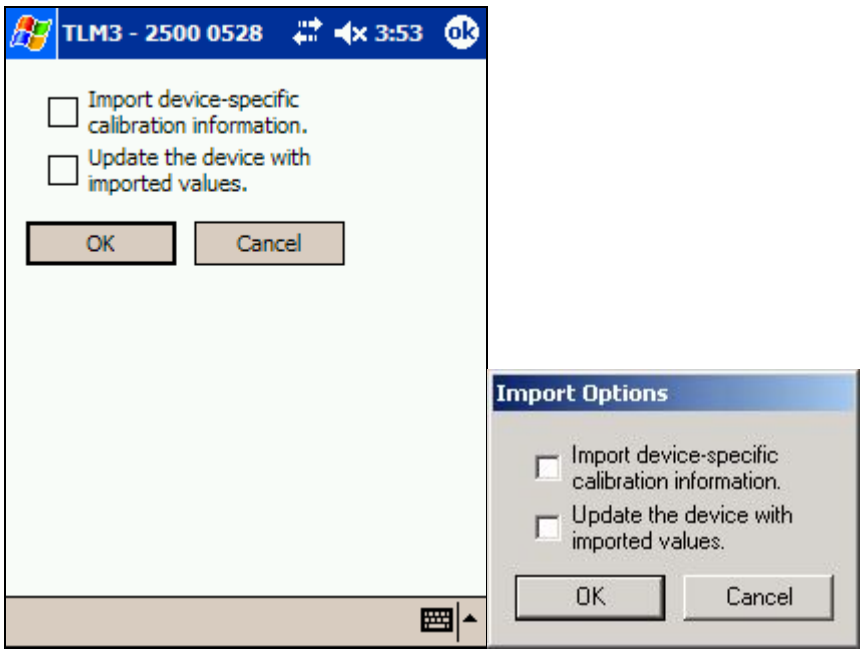
Import Config applies a saved configuration to the TLM-3. This saves time if the configuration settings are similar among several TLM-3s, or if a TLM-3 previously in service has failed and is being replaced.

To import a saved configuration,

- Tap **File** > Import. The File Open box will be displayed. Tap the configuration file you want to import. (On the PC, tap the ***Open*** button.)



An import options page will be displayed.



- Check both boxes.
- Tap the ***OK*** box. The configuration file is imported, and the device configuration is updated.

Export Config saves the TLM-3 configuration data as a CSV file. The export procedure is the same as described in the Data screen section.

Action menu items:

- Refresh.
- Save.
- Sync Clock.
- Site Calibration.
- Change Frequency Band…

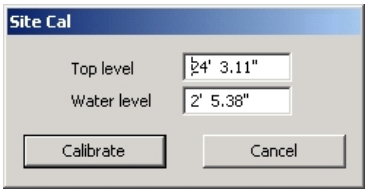
Refresh refreshes the data on the Configuration screen.

Save is the same as the ***Save*** button.

Sync Clock synchronizes the TLM-3 real-time clock to the PDA or PC clock.

Site Calibration sets the Top and Water levels reported by the TLM-3 to match a manual gauge. To run Site Cal:

- Gauge the tank levels manually and record the level values.
- Tap **Action** > Site Calibration. The Site Cal box is displayed.

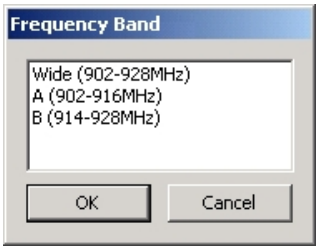


- Enter the Top and Water levels you measured when you gauged the tank.
- Tap ***Calibrate***.
- The TLM-3 Top and Water level offsets are automatically set to match the gauged levels.

Change Frequency Band allows you to configure the TLM-3 radio to minimize interference from some SCADA radios (e.g. FreeWave). Many SCADA radios, including FreeWave, can be set to use only a part of the 902 – 928MHz radio band. If you configure the SCADA radio to use the upper band and the TLM-3 to use the lower band, the two radios will not interfere and communications will be much faster and more reliable.

To change the TLM-3 frequency band:

- Tap **Action** > Change Frequency Band. The Frequency Band window opens.



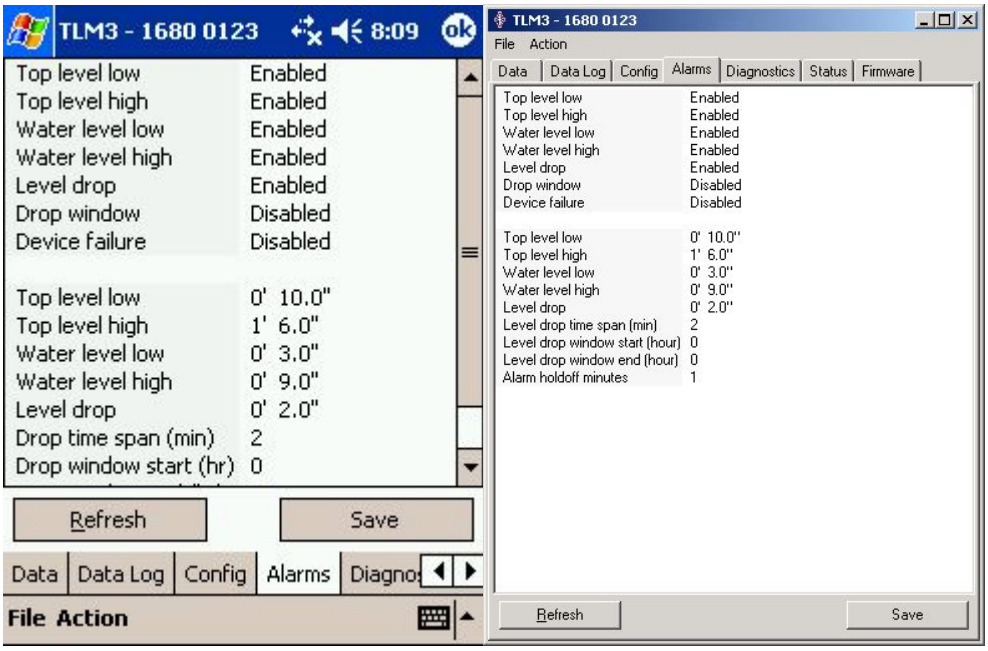
- The TLM-3 radio can be set to one of three modes: **Wide** (the entire 902 – 928MHz range), **A** (the lower band, 902 – 916MHz) or **B** (the upper band, 914 – 928MHz).

- Tap the desired mode to highlight it and tap ***OK***.

Note that this requires a similar configuration of the SCADA radio system. Refer to the SCADA manufacturer's data for information on how to configure the SCADA system.

Alarms page

The TLM-3 can generate alarms and send alarm messages to the CCU.



Alarms page actions

- Enable and disable alarms.
- Set alarm trip points for Top and Water levels. Each float level has independently configurable high and low level alarm setpoints.
- Set a Level Drop alarm.
- Set an Alarm holdoff time.

To enable or disable an alarm:

- Tap the ***Enabled*** value beside the alarm you want to enable.
- Tap ***Save***.

To set alarm trip points:

- Tap the level setpoint value you want to change. (PDA: The keyboard will pop up.)
- Enter the setpoint value in feet and inches.
- Tap ***Save***.

To minimize nuisance alarms, **Alarm holdoff** sets the time that an alarm condition must be present before the TLM-3 will send an alarm. The longer the holdoff time, the longer the alarm condition has to last before an alarm is generated. This minimizes nuisance alarms.

To set the Alarm holdoff:

- Tap the Alarm holdoff value. On the PDA, the keyboard will pop up.

- Enter the desired value in feet and inches.
- Tap ***Save***.

Level drop alarms sends an alarm when the oil level drops a set depth during a selectable time span (for example, if oil is "thieved" at night when the tank is unattended). Level drop alarm configuration requires four values:

- Level drop (in feet and inches) sets the fluid level drop necessary to trigger an alarm.
- Drop time span (in minutes) sets the maximum time interval necessary to trigger an alarm.
- Drop window start and end (24 hour format, local time) sets a "window" during which a level drop alarm can be generated. This prevents sending an alarm during the normal workday.
- To disable the Level drop alarm, set the Start and End values to the same value.

To set the Level drop values:

- Tap the Alarm holdoff value. On the PDA, the keyboard will pop up.
- Enter the desired value in feet and inches.
- Tap the ***Save*** button.

For example, assume that you want to detect a Level drop and trigger an alarm if the oil (Top) level drops more than 1' in 10 minutes, between 7PM and 5AM. In this case, set:

- Level drop = 1' 0"
- Drop time span = 10 minutes
- Drop window start = 19 (PM values add 12, so 7PM = 12 + 7)
- Drop window end = 5 (AM values don't add 12, so 5AM = 5)

Alarm menus

- **File**.
- **Action**.

File menu items:

- Import Config.
- Export Config.

Import Config and Export Config load and save TLM-3 configuration files.

Action menu items:

- Enable.
- Refresh.
- Save.

Enable is the same as the Enable checkbox.

Refresh and Save refresh the Alarm values page and save your changes. They are the same as the ***Refresh*** and ***Save*** buttons.

Diagnostics page

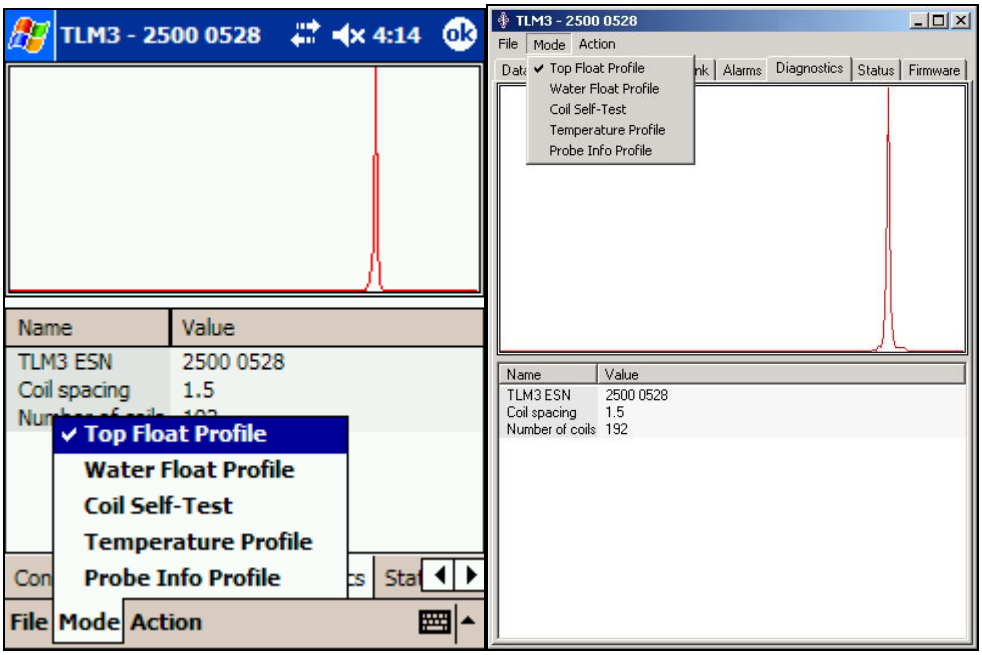
The TLM-3 has built-in diagnostics which, combined with Status page information, show the health of the floats and probe cards.

The most useful modes are the Top Float Profile, Water Float Profile and Coil Self-Test. (The Temperature Profile is presently unsupported. The temperatures read by the probe processors are uncalibrated and are usually inaccurate. The Probe Info Profile information is only of use to iMonitoring engineering.)

Diagnostics page actions

- Read the Top float profile.
- Read the Water float profile.
- Read the Coil Self-Test results.
- Read the Temperature Profile.
- Read the Probe Info Profile.

Top and Water float profiles



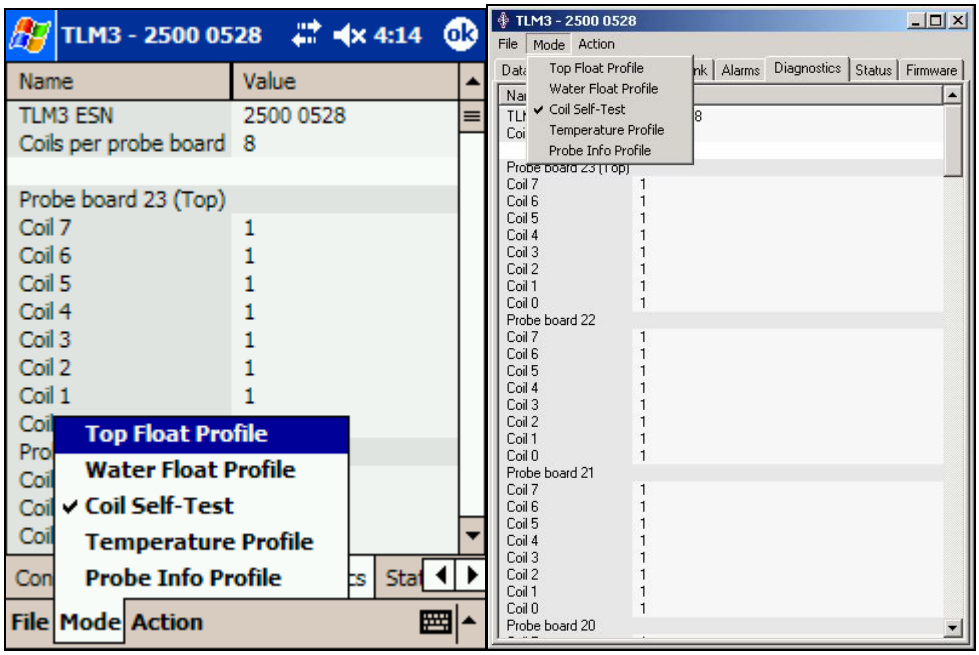
These profiles indicate the approximate position of the floats (the horizontal scale runs from 0' at the left of the screen to the top of the upper probe card (about the top of the tank) at the right. If a red peak is seen, the probes are detecting the float's signal and are able to process the position information. If no peak is seen, either the float or probe cards have a problem. This page begins by presenting the Top Float Profile.

To read the Top or Water float profiles,

- Tap **Mode**.

- Tap **Top Float Profile** or **Water Float Profile** to display the profile.

Coil self-test



The Coil Self-Test page displays each probe card's coil status. Each probe has eight coils, numbered 0 through 7. A '1' beside the coil indicates a good coil. 'Failure' indicates a bad coil. NOTE: There are occasional false failures displayed with the coil self-test. A coil should only be considered bad if you see a "failure" in three or more consecutive coil tests.

Although the TLM-3 will operate even with several bad coils, this introduces gaps in the level spans (the reported level may jump abruptly from one level to the next in a 2" or 3" step, rather than moving smoothly in 0.1" steps as it should.) This diagnostic allows an installer to identify and replace only the bad probe card rather than the entire assembly.

To check Coil Self-Test results:

- Tap **Mode**.
- Tap **Coil Self-Test**.
- The results are displayed.

Diagnostics menus

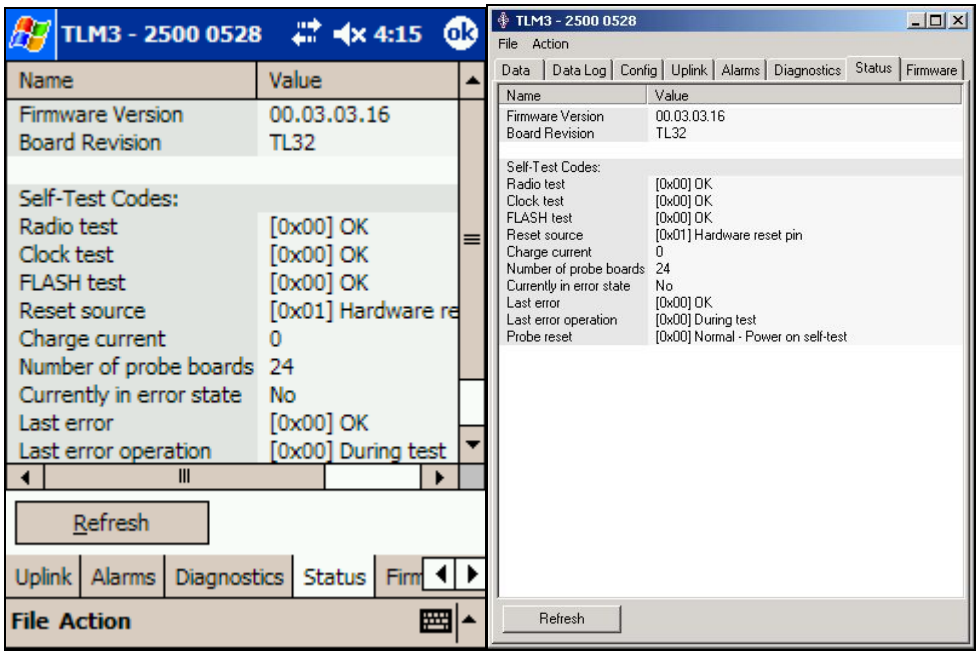
- **File.**
- **Mode.**
- **Action.**

File > Export is nonfunctional.

Mode menu items:

- Top Float Profile. See above.
- Water Float Profile. See above.
- Coil Self-Test. See above.
- Temperature Profile displays the temperature of each probe processor. NOTE: This feature is not presently supported. The displayed values are uncalibrated and may be very inaccurate.
- Probe Info Profile displays the Probe board type, firmware revision, coil type, number of coils and coil spacing for each probe card. This information is for iMonitoring engineering use.

Status page



The Status page displays information about the TLM-3 system. The following information is presented:

- Firmware version. The sensor head firmware version.
- Board (hardware) revision. The sensor head hardware revision.
- Self-test codes:
  - Radio test. Should display ‘OK’. If it fails, a brief failure description is displayed.
  - Clock test. Should display ‘OK’. If it fails, a brief failure description is displayed.
  - FLASH test. Should display ‘OK’. If it fails, a brief failure description is displayed.
- Reset source. Should display ‘hardware reset pin’ (the reset pushbutton). There are other reset sources; some may indicate a problem.
- Charge current. This represents the amount of charging current generated by the solar panel. In average sunlight this value is typically > 40. If the value is 0 in sunlight, there is probably a failure in the solar panel or charging circuit.
- Number of probe boards. This number should match the number of probe cards in the TLM-3.
- Error codes. This information is useful when working with iMonitoring customer support regarding a device failure.
  - Currently in error state. If the TLM-3 detects an error, it will display ‘Yes’ if the error is still present, or ‘No’ if the error is no longer present.
  - Last error displays the last error detected.
  - Last error operation displays the operation where the error was detected.
- Probe reset should display ‘Normal - Power on self-test’. Other reset conditions may be displayed.

Status page actions

- Refresh displayed status information.
- Export TLM-3 status information (menu item only).
- Run the RF Link Test (menu item only).

To refresh status information:

- Tap the ***Refresh*** button.

Status menus

- **File.**
- **Action.**

File > Export saves the status information to a CSV file. The export procedure is the same as described earlier in the Data page.

Action menu items:

- Refresh.
- RF Link Test...

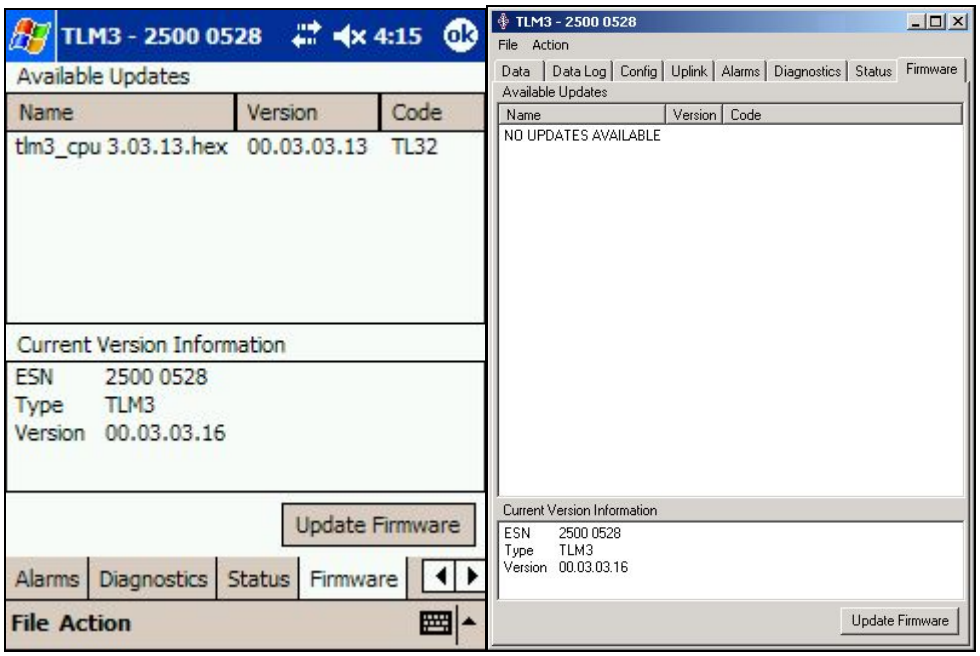
Refresh is the same as the ***Refresh*** button.

RF Link Test is similar to Data Loop, collecting information from the TLM-3 continuously. The Frequency selection box is identical. However all collected data relates to the spread spectrum channel hopping radio system used in all iNodes. RF Link Test displays and records:

- Time of collection in 24-hour format, local
- CFR RX Channel (inbound channel number)
- CFR Rssi (inbound signal strength)
- CFR TX Channel (outbound channel number)
- Dev RX Channel (outbound
- Dev Abs RSSI (inbound signal strength, seen on the TLM-3)
- Dev thres (noise threshold of the received channel on the TLM-3)
- Dev margin (noise margin of the received channel on the TLM-3)
- Timing offset (timing alignment value synchronizing the TLM-3 and CFR radios)

RF Link Test is usually only used by Ferguson Beauregard for system troubleshooting.

Firmware page



TLM-3 firmware can be updated on the Firmware screen.

Firmware page actions

- View the current version information (ESN, Type and Version).
- Load a new firmware version.

On the PDA, new firmware versions must be copied into the iNodeConfig folder using ActiveSync. All TLM-3 firmware versions in the iNodeConfig folder will be displayed in the top box on the screen.

On the PC, firmware can be located in different folders since you can browse folders to find the files.

To load a different firmware version,

- Tap the version to be loaded to highlight it.
- Tap the ***Update Firmware*** button. If the version is older than the one presently loaded, a notification box will be displayed. Tap the ***OK*** button to proceed.
- A confirmation box will be displayed. Tap ***Yes*** if you want to proceed.
- The new firmware will be loaded.

CAUTION: This process takes several minutes. Don't do anything else with the PDA until the upload is complete.

Firmware menus

- **File.**
- **Action.**

File menu items:

- Browse Available Directories.
- Refresh Available Updates.

On the PDA, Browse available directories is nonfunctional. On the PC, you can browse to any directory on the PC to find firmware files.

If firmware files have been copied into the iNodeConfig folder on the PDA, or you have browsed to a new folder on the PC, Refresh available updates will display the new files in the upper window.

Action menu items:

- Update Firmware.
- Refresh Version Info.

Update Firmware performs the same action as the ***Update Firmware*** box.
Refresh Version Info will display the current TLM-3 firmware version.

TLM-3 Specifications

Measurement		
	Probe length	1’ to 31’
	Accuracy	+/- 0.1” (24’ probe length)
	Resolution	+/- 0.01”
	Number of floats	1 or 2, supports single or dual product tanks
Electrical		
	Radio range: Sensor to CCU	1,500 feet typ. line of sight. > 5000 feet with optional high gain antenna.
	Radio range: Sensor to CFR-enabled device	500 feet.
	Radio technology	902-928 MHz spread spectrum frequency hopping.
	Communications protocol	Proprietary iMECH protocol specifically designed for iNode wireless sensors
	Security	Access to sensor data can be restricted by cypher
	Data logging	Internally stored data logs, 30 day length
	Power	Solar panel, rechargeable Li-Ion battery and integrated charger/regulator
Mechanical		
	Mounting	3” (76.2 cm) dia NPT
	Probe tubing material	FRP fiberglass
	Tubing diameter	1.10” OD nominal
	Standard tubing lengths	7.5’, 2.5’
	Float diameter	3” O.D. nominal
Environmental		
	Operating temperature	-40^{o}C to + 60^{o}C (-40^{o}F to 140^{o}F)
	Humidity	0 to 95% non-condensing
Certifications		
	Safety listings	UL and c-UL Class l, Div. l, Groups C and D (Intrinsically safe)
	FCC approval	CFR 47 Part 15
Reliability		
	Product life	$\geq$ 5 years by design

The Ferguson Beauregard iNodes suite of products includes:

- Tank Level Monitor (TLM, TLM-E, TLM-3)
- Wireless Data Switch (WDS)
- Electronic Flow Monitor (EFM)
- Compact Flash Radio (CFR)
- Wireless Pressure Monitor (WPM)
- Concentration & Communications Unit (CCU)
- CCU with Modbus™ Gateway (Modbus Gateway)
- CCU with RTU analog and digital input interface (CCU-RTU)

Other Services compatible with our iNodes suite:

FieldDIRECT® is an end-to-end service for collecting and storing production data and delivering it directly to your desktop via a Web-based interface. It operates seamlessly with our iNodes intelligent sensors and our handheld data entry system, providing data capture options that are economical even in mature fields with wells producing as little as five BOE per day.

For more details on iNodes and FieldDIRECT, call 1-903-561-4851, fax (903) 561-6567, visit our Web site at www.FergusonBeauregard.com/products, or send an e-mail to: automation@fergusonbeauregard.com.

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